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Notes on three species of the genus Sacculina[1])

by

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One of the specimens dealt with in the present paper has been described in previous papers, in which it appeared under three different names, all of which for different reasons eventually proved to be erroneous. The present identification as *Sacculina cordata* Shiino at last seems to be definite. The second specimen, as the first from the material collected by the Siboga Expedition, belongs to the species *Sacculina papposa* V. K. & B., of which up till now the type specimen only was known; the parasite dealt with here is interesting because the excrescences of its external cuticle are of a structure slightly different from that of the corresponding parts in the type; moreover, in this specimen retinacula were found, yielding an additional character for the definition of the species. The remainder of the material dealt with here proved to belong to a new species, characterized in the first place by the peculiar excrescences of the external cuticle.

Sacculina cordata Shiino

p. p. *Sacculina pilosa*, Boschma, 1928, p. 155, specimen on *Tiarinia gracilis* Dana, fig. 2 *c* (excrescence of external cuticle).

p. p. *Sacculina rotundata*, Boschma, 1931, p. 21, specimen on *Tiarinia gracilis* Dana.

Sacculina cordata Shiino, 1943, p. 13, specimen on *Tylocarcinus styx* (Herbst), fig. 1 G (left side), fig. 9 (male organs, colleteric gland, excrescences of external cuticle).

Sacculina synaptothrix Boschma, 1948, p. 941, specimen on *Tiarinia gracilis* Dana, fig. 3 *a* (left side), fig. 4 (male organs), fig. 5 *a—c* (colleteric gland), fig. 6 (excrescences of external cuticle); specimens on *Tylocarcinus styx* (Herbst), fig. 3 *b, c* (left side), fig. 5 *d—f* (colleteric glands), figs. 7, 8 (male organs), fig. 9 (excrescences of external cuticle).

In the first paper dealing with the Rhizocephala of the Siboga Expedition (VAN KAMPEN & BOSCHMA, 1925) the recognized specific characters of the Sacculinidae were almost exclusively those of the excrescences of the external cuticle. Accordingly nearly all specimens with groups of fairly large spines united on common basal parts were identified as *Sacculina pilosa* Kossmann. A subsequent revision of the material (BOSCHMA, 1931) led to the result that, especially on account of anatomical characters, a few specimens formerly included in *S. pilosa* had to be described as separate species, whilst a number of other specimens of the same group now were identified as *S. rotundata* Miers. In a later paper (BOSCHMA, 1948) it was shown that the specimens

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regarded as *S. rotundata* formed a heterogeneous group, so that two new species, *S. spectabilis* and *S. synaptothrix*, had to be described. At that time I had not yet seen the important paper on Japanese Rhizocephala by SHIINO (1943), a copy of which was kindly lent to me by Dr. E. G. REINHARD during a visit to Washington, D. C., in May, 1949; I am much obliged to Mrs. A. H. CLARK (Smithsonian Institution, Washington, D. C.), for a photostatic copy of the cited paper. SHIINO (1943, p. 13) described the species *Sacculina cordata*, a parasite of *Tylocarcinus styx* (Herbst); the description and the excellent figures show beyond any doubt that this is the same species as that described in a later paper (BOSCHMA, 1948) as *S. synaptothrix*, so that the latter name is to be considered a synonym of *S. cordata*. The synonymy is noted above, a few additional notes on the species are given below.

The three specimens described as *Sacculina synaptothrix* indubitably are conspecific with SHIINO's type specimen of *S. cordata*. As far as concerns their external shape they do not show important differences, though but one of the three specimens from the East Indies (BOSCHMA, 1948, fig. 3 *c*) approximates the cordiform shape of the type specimen (SHIINO, 1943, fig. 1 G). In the four specimens the region of the mantle opening does not noticeably protrude over the surface of the mantle; the male organs are of a similar structure; and the colleteric glands do not present too conspicuous differences in number and distribution of their system of canals (up to 11 in a longitudinal section of the Japanese specimen, in the East Indian specimens up to 14, 22, and 16 respectively). The excrescences of the external cuticle of the mantle in the four specimens have a similar shape; in the Japanese specimen on *Tylocarcinus styx* they have a total length of 85—100 μ, in the East Indian specimens on the same crab they have a maximal length of 120 μ, and in the specimen on *Tiarinia gracilis* they measure 75—90 μ.

SHIINO (1943, p. 14) remarks that *Sacculina cordata* closely resembles *S. compressa* Boschma, parasitic on *Ozius tuberculosus* H. M. E. and on *Eriphia laevimana* Latr., and, moreover, he suggests that the parasites of the two mentioned crabs probably are specifically distinct because of differences in the shape of the male organs.

As far as concerns the differences between *Sacculina cordata* and *S. compressa* it must be admitted that the two species are characterized by cuticular excrescences of a similar shape; the striking differences in the sizes of the excrescences, however, distinctly point to a specific distinction of the two forms: in *Sacculina compressa* they remain smaller than 30 μ, whilst in the four known specimens of *S. cordata* the maximum size of the excrescences varies from 90 to 120 μ.

If really the two known specimens of *Sacculina compressa* are specifically distinct it will prove to be so primarily on account of the colleteric glands that in the specimen on *Eriphia laevimana* have a much greater number of canals than in the specimen on *Ozius tuberculosus*. The male organs of the two specimens are not principally different, as in both specimens the vasa deferentia join the testes by means of a narrow canal with a chitinous inner wall. The external cuticle of the mantle, that in the two specimens is of approximately equal thickness, bears excrescences of a somewhat different appearance; the latter difference, however, is too slight to be defined as a constant specific character.

Sacculina papposa Van Kampen & Boschma

Sacculina papposa Van Kampen & Boschma, 1925, p. 41, fig. 28 (excrescences of the external cuticle).

Sacculina papposa, Boschma, 1931, p. 44, fig. 5*m* (left side), fig. 27 (longitudinal section with male organs and colleteric glands).

Sacculina papposa, Boschma, 1937, p. 287, fig. 67 (male organs and colleteric gland).

The data given above refer to a specimen on *Thalamita admeta* (Herbst), collected in the Banda Islands by VAN DER VELDE. Afterwards, among the material brought together by the Siboga Expedition, a crab identified as *Thalamita* spec. was found to be infested by a parasite belonging to *Sacculina papposa*. The specimen was collected in the Banda Islands, the locality of the type of the species. It differs in minor details from the previously described specimen, so that an account of its chief peculiarities is here given.

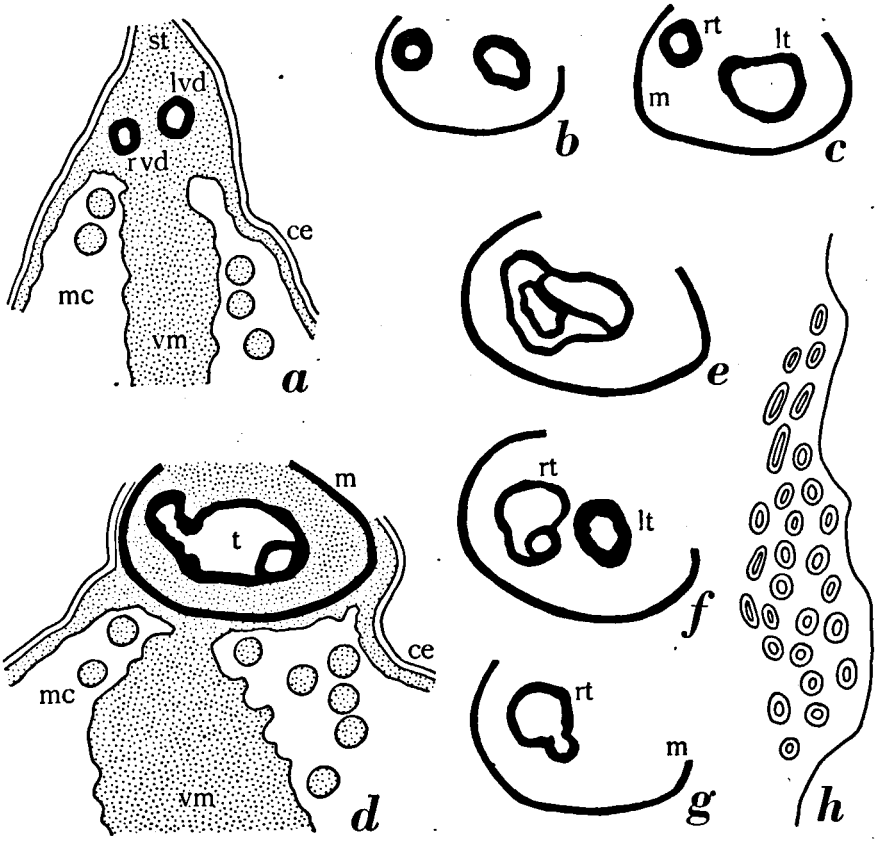

Fig. 1. *Sacculina papposa* Van Kampen & Boschma, specimen on *Thalamita* spec. *a*, posterior part of a longitudinal section containing the vasa deferentia; *b*, *c*, transverse sections of the male organs from a more dorsal region than *a*; *d*, posterior part of a longitudinal section, dorsally of *c*; *e—g*, transverse sections of the male organs in regions dorsally of *d*; *h*, longitudinal section of one of the colleteric glands. *ce*, external cuticle of the mantle; *lt*, left testis; *lvd*, left vas deferens; *m*, muscular sheath surrounding the testes; *mc*, mantle cavity; *rt*, right testis; *rvd*, right vas deferens; *st*, stalk; *t*, the two united testes; *vm*, visceral mass. *a—g*, x 43; *h*, x 180.

The parasite is slightly larger than the type specimen of *Sacculina papposa*, its greater (dorso-ventral) diameter is about 7 mm, its antero-posterior diameter is about 4 mm, and its thickness about 2½ mm. The shape is similar to that of the type specimen (cf. BOSCHMA, 1931, fig. 5 *m*); it is slightly less symmetrical as the dorsal half is higher than the ventral. As in the type specimen the region of the mantle opening only slightly rises above the mantle.

The male organs of the specimen here described differ in some respects from those of the type specimen. The vasa deferentia (fig. 1 *a*) are comparatively narrow canals that gradually pass into the testes (fig. 1 *b*, *c*); on their inner wall there is not a layer of chitin as was found in one of the male organs of the type specimen. Towards the dorsal region the testes unite into one cavity, though more or less irregularly parts of the combined male organs remain separated from the larger cavity by internal walls extending for some distance (fig. 1*d*, *e*).

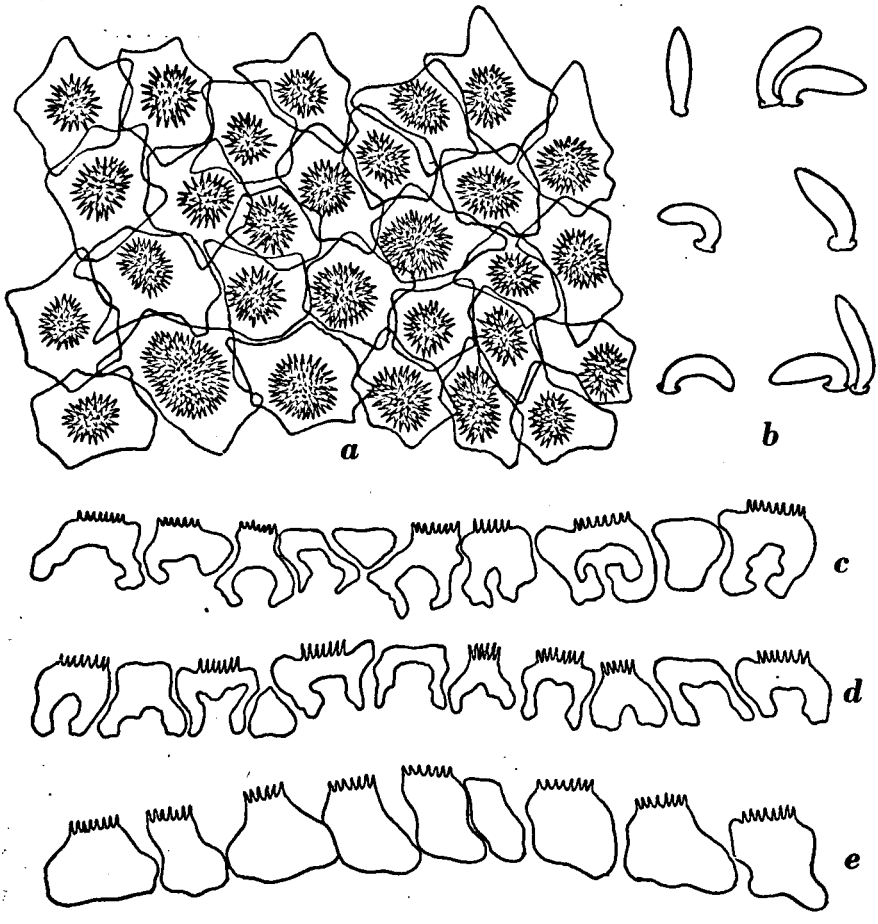

Fig. 2. *Sacculina papposa* Van Kampen & Boschma, specimen on *Thalamita* spec. *a*, excrescences of the external cuticle in surface view; *b*, retinacula; *c*—*e*, excrescences of the external cuticle, drawn from sections. x 480.

In their dorsal ends the two testes become separated again, here also parts may be partitioned off internally (fig. 1*f*). The right testis extends slightly farther dorsally than the left (fig. 1*g*). The testes are surrounded by a muscular sheath (*m* in the figures) that is not continuing around the vasa deferentia.

When compared with those of the type specimen the male organs of the specimen dealt with here show some differences. In the type specimen the dorsal parts of the testes are united into a common cavity, whilst in the specimen described here the dorsal extremities of the testes are separated. This difference, together with the irregular division of the united testes into partly separate cavities, is to be regarded as a result of individual variation, the situation in general being the same in the two specimens.

The colleteric glands of the type specimen (cf. BOSCHMA, 1931, fig. 27; 1937, fig. 67 *i* — *m*) distinctly protrude over the lateral surfaces of the visceral mass; the maximal number of canals in a longitudinal section amounts to 18. In the specimen here described the colleteric glands do not noticeably protrude over the surfaces of the visceral mass, and the number of canals is slightly larger, up to 28 in a longitudinal section (fig.1 *h*). In this specimen the canals of the colleteric glands possess well developed internal layers of chitin. The arrangement of the canals is not appreciably different in the two specimens.

The surface of the external cuticle of the mantle is densely covered with excrescences consisting of chitin different from the main layers of the cuticle by its hyaline structure. These excrescences are of an irregularly polygonal shape; on its top each excrescence bears a circular or oval tuft of crowdedly arranged small spines (fig. 2*a*). In sections of the cuticle it appears that generally the basal part of the excrescences has a more or less irregular cavity (fig. 2 *c*, *d*), in some parts of the cuticle the excrescences consist of more solid lumps of hyaline chitin (fig. 2 *e*). The measurements of the excrescences are given in the following table, next to those of the type specimen.

	specimen on *Thalamita admeta* (Herbst)	specimen on *Thalamita* spec.
diameter of excrescences	22 — 40 μ	15 — 45 μ
diameter of tufts of spines	15 — 26 μ	12 — 27 μ
height of excrescences	22 μ	18 — 30 μ
length of spines	$3^1/_2$ — 6 μ	3 — 6 μ

The data here given show that the excrescences of the two specimens correspond in every important detail. Some slight differences must be noted here. In the type specimen the greater part of the excrescences consists of a kind of chitin not differing from that of the main layers, this chitin is covered by a thin external layer of a hyaline structure (VAN KAMPEN & BOSCHMA, 1925, fig. 28). In the specimen here described the hyaline chitin forms a much thicker layer, sometimes even the excrescences consist entirely of this matter (fig. 2 *c* — *e*). A further slight difference is that of the size of the spines, these are weaker and thinner in the type specimen, somewhat stronger in the specimen dealt with in the present paper.

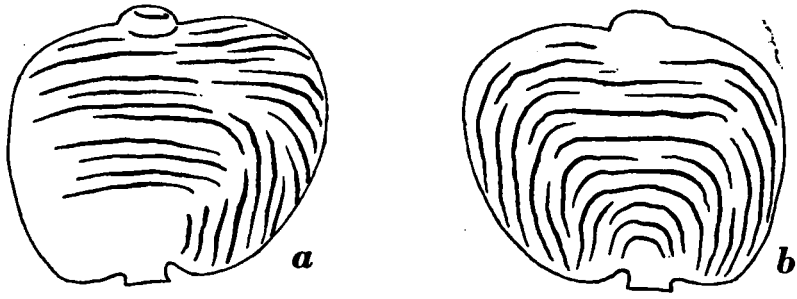

Fig. 3. *Sacculina pistillata* nov. spec., holotype. *a*, left side ; *b*, right side. x 3.

In the type specimen no retinacula were found on the parts of the internal cuticle examined for this purpose. These structures occur in the specimen on *Thalamita* spec. The retinacula are fairly regularly distributed over the surface of the cuticle ; they consist of one spindle, rarely of two, straight or more or less curved, of a length of 23—30 μ. The spindles seem to be devoid of barbs. Six retinacula are shown in fig. 2*b*, in reality they are much more widely distributed than as represented in the figure.

Sacculina pistillata nov. spec.

Sultan Shoal, off Singapore Island, 1933, 3 specimens on *Atergatis integerrimus* (Lam.), M. W. F. TWEEDIE leg.

Specific characters. Male genital organs in the posterior part of the body, outside the visceral mass. Testes globular, abruptly passing into the narrow vasa deferentia. Colleteric glands with a small number of canals that are nearly completely arranged in one row parallel to the surface of the glands. External cuticle of the mantle with excrescences consisting of hyaline chitin, different from that of the main layers. The excrescences are composed of a hollow basal part and a number of spines : a larger central blunt protuberance and a circular row of smaller spines. Diameter of the excrescences 12—21 μ, total height 22—30 μ. Retinacula unknown.

Two of the specimens were attached to one crab, in one of these the internal anatomy was studied ; this specimen may be regarded as the holotype of the species. It is of an irregularly oval shape (fig. 3); its greater (ventro-dorsal) diameter is 14 mm, its antero-posterior diameter 11 mm, and its thickness 4½ mm. The region of the mantle opening protrudes as a small tube over the surface of the mantle. The mantle shows numerous parallel, more or less concentric grooves.

The other specimens do not differ in any important detail from the holotype.

The male genital organs are found in the region of the stalk, outside the visceral mass. The testes are more or less globular, the one is situated slightly behind the other, the left has a more ventral position, the right is found farther dorsally (fig. 4 *a*—*d*). The narrow vasa deferentia have simple walls without any internal ridges. When passing into the testes the inner walls of the vasa deferentia possess distinct layers of

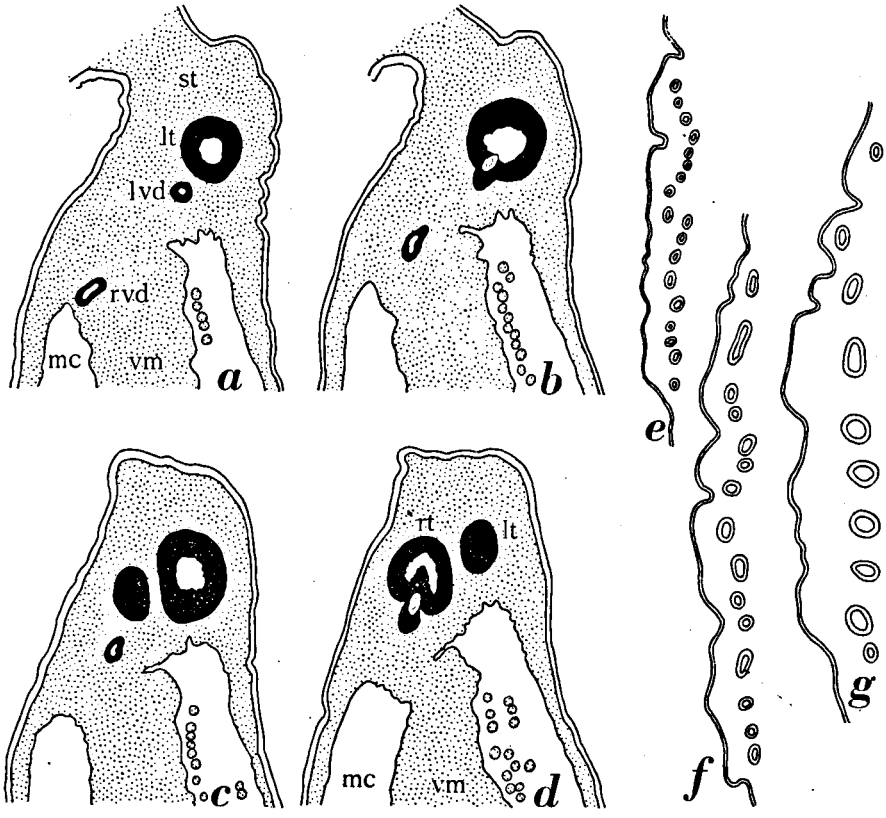

Fig. 4. *Sacculina pistillata* nov. spec., holotype. *a—d*, posterior parts of longitudinal sections; *a*, from the region of the stalk, each following section from a more dorsal region. *e—g*, longitudinal sections of one of the colleteric glands, from the peripheral part and from more central regions successively. *lt*, left testis; *lvd*, left vas deferens; *mc*, mantle cavity; *rt*, right testis; *rvd*, right vas deferens; *st*, stalk; *vm*, visceral mass. *a—d*, x 16; *e—g*, x 72.

chitin; this region of transition is shown for the left testis in fig. 4 *b*, for the right testis in fig. 4 *d*.

The colleteric glands occur in the anterior half of each lateral surface of the visceral mass as comparatively flat organs. They contain a rather small number of canals, nearly completely arranged in one row parallel to the surface of the glands. In the central region the canals are few and wide (fig. 4 *g*), gradually they become narrower and more numerous (fig. 4 *f*), and in the peripheral region they are still narrower and more strongly divided (fig. 4 *e*); the maximum number of canals counted in one longitudinal section is 18. In the sectioned specimen the canals of the colleteric glands contain well developed layers of chitin.

In the sectioned specimen (the holotype) the external cuticle has a thickness of 45—75 μ. Its surface is densely covered with small excrescences that have a diameter of 12—21 μ, and a total height of 22—30 μ. The excrescences consist of a basal part with a central cavity, open below, and a circular row of small spines surrounding a central blunt

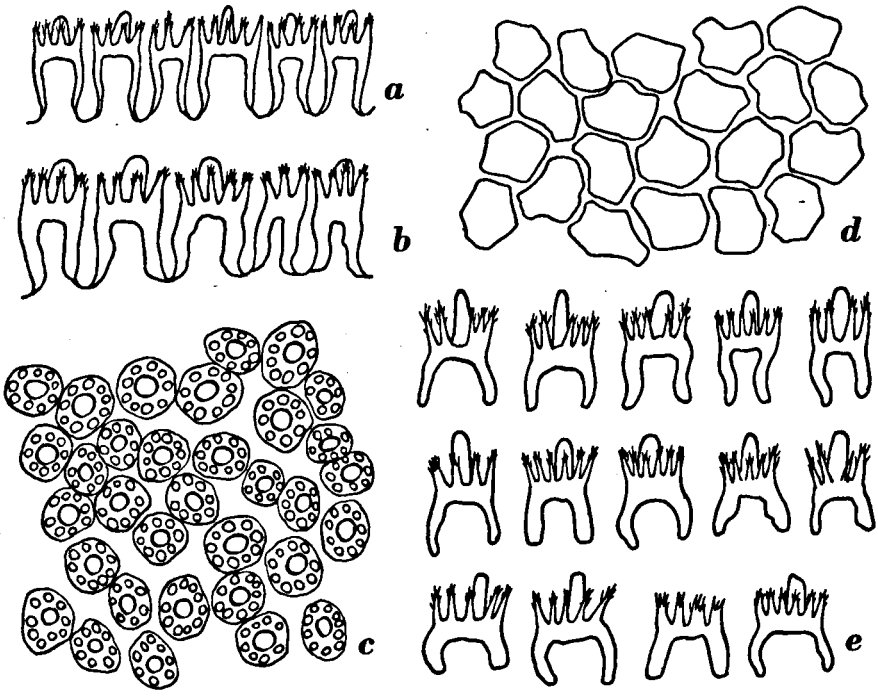

Fig. 5. *Sacculina pistillata* nov. spec. *a, b,* upper parts of sections of the external cuticle of the holotype, showing the excrescences. *c—e,* excrescences of the solitary specimen ; *c,* lower parts of the spines in surface view ; *d,* basal parts of the excrescences, seen from below ; *e,* isolated excrescences, basal parts drawn in optical section. x 515.

protuberance in the shape of a minute pestle (fig. 5 *a, b, e*). The excrescences consist of a hyaline kind of chitin, strongly refractive in comparison with the main layers of the cuticle. In surface view the central protuberances are very conspicuous as they converge the light in the manner of lenses, then the surrounding parts of the excrescences appear much more opaque. An optical section of the upper region of the excrescences is shown in fig 5 *c*, the contours of a number of basal parts of excrescences are represented in fig. 5 *d*. The central protuberances and the rows of spines show some variation in size and in thickness (fig. 5 *a, b. e*).

No retinacula were found on the parts of the internal cuticle examined.

The excrescences of *Sacculina pistillata* are similar to those of *S. hystrix* (cf. VAN KAMPEN & BOSCHMA, 1925, p. 44). In *S. hystrix* the external cuticle of the mantle is about 16 μ thick, much thinner than that of *S. pistillata*. A more striking difference between the two species is the dissimilarity in structure of the excrescences, which in *S. pistillata* consist of hyaline matter, and in *S. hystrix* apparently of the same kind of chitin as that of the main layers. Moreover, the excrescences of *S. hystrix* are less than half as high as those of *S. pistillata*.

Unfortunately the male organs of *S. hystrix* are not sufficiently known

to allow of a comparison with those of *S. pistillata*. The colleteric glands of *S. hystrix* have about half the number of canals of those of *S. pistillata*.

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